DWNT/Hydrogenated Fullerene Reinforced Polyethylene for Radiation Shielding Applications, Phase II

Completed Technology Project (2005 - 2007)

Project Introduction

Phase I has demonstrated the feasibility of the overall objective to develop strong and lightweight polyethylene composites with double-walled nanotubes for radiation shielding applications. Multi-gram quantities of pure DWNTs, hydrogen-containing functional derivatives of DWNTs, highly hydrogenated fullerenes have been synthesized and incorporated in polyethylene matrix to form composite materials of exceptional mechanical strength, thermal stability and enhanced proton radiation shielding efficiency. The tensile strength of the low-density polyethylene composites with DWNTs was evaluated to be in excess of 200 MPa, and the Young's modulus exceeds 3500 MPa, while the composite toughness is retained at a very high level of ca. 10 J/cm3. These values compare favorably to the strongest polymer films, including those of aramide polymers. The thermal oxidation degradation point of polyethylene is up-shifted by more than 100

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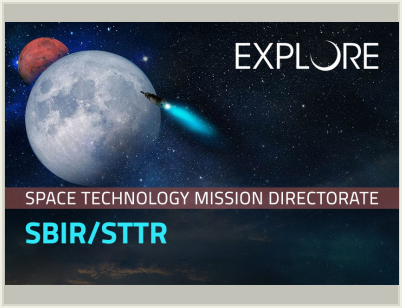
C at 1 wt. % loading of the DWNT filler. A prominent increase in proton radiation shielding efficiency, reaching 35 % in terms of water equivalence thickness was obtained for composites containing DWNTs and fullerene hydrides. Virtually no degradation in properties was observed upon proton irradiation. In Phase II, the central technological achievement of Phase I effort, the effective lamination of the unique as-produced DWNT films with polyethylene will be further developed for manufacturing practical composite articles for aerospace applications, including advanced components for EVA suits. The DWNTs, fullerene hydrides and appropriate thermoplastic polymers will be explored for composite components.

Anticipated Benefits

Potential NASA Commercial Applications: ? Advanced tapes for magnetic recording ? Materials for soldier armor vests and helmets ? Materials for EMI shielding ? Advanced sails for yachts ? Materials for sports equipment, tennis rackets, race cars ? Materials for bio-medical applications, bone scaffolds.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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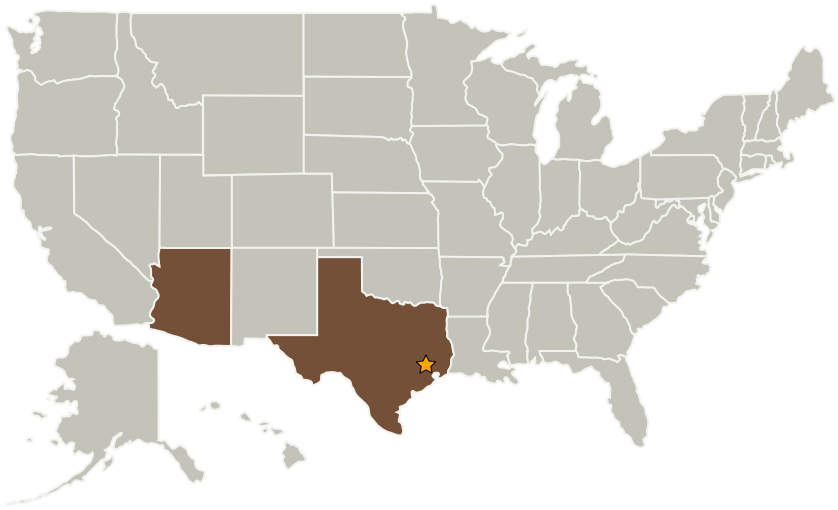
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
MER Corporation	Supporting Organization	Industry	Tucson, Arizona

Primary U.S. Work Locations	
Arizona	Texas

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Raouf O Loutfy

Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.2 Test and Qualification
    - TX13.2.2 Propulsion, Exhaust, and Propellant Management